

Short Term and Long Term Linkages among Nonperforming Loans, Macroeconomic and Bank-Specific Factors: An Empirical Analysis for Turkey

Takipteki Krediler, Makroekonomik ve Banka Özellikli Faktörler Arasındaki Uzun ve Kısa Dönemli İlişkiler: Türkiye için Ampirik bir Analiz

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ABSTRACT

This paper investigates the linkages among the nonperforming loans and different macroeconomic and bank-specific factors in the Turkish banking sector over the period 2007-2013. The study is motivated by the hypothesis that both different macroeconomic and bank-specific variables have an effect on the quality of the loans. The long run relationship among the non-performing loans and these variables is analyzed by using Johansen-Juselius (1990) cointegration tests; short-run dynamics is tested through Granger Causality test, and the direction of the causality, through the Vector Error Correction Model (VECM). The results show that there exists consistent and strong long-run relationship among the nonperforming loans, macroeconomic variables and bank-specific factors. However, the short-term causal relationships are considerably limited, and, where they exist, especially unidirectional.

Keywords: Non-performing loans, Cointegration, Vector Error Correction, Turkish banking sector.

ÖZET

Türk Bankacılık sektöründe 2007-2013 yılları itibarıyla takipteki krediler ile takipteki kredilerin belirleyicileri arasındaki ilişkiyi araştırmayı amaçlayan bu çalışma, hem makroekonomik hem de banka-özellikli değişkenlerin kredilerin kalitesi üzerinde etkisi olduğu hipotezi üzerine kurgulanmıştır. Takipteki kredileri etkileyen banka-özellikli değişkenler, banka kartlarının hacmi, toplam tasarruf mevduatı; makroekonomik değişkenler ise TCMB gecelik borç verme faiz oranı, işsizlik oranı, enflasyon, kişi başına GSYİH ve cari açık olarak tespit edilmiştir. Seriler arasındaki uzun dönemli dinamik ilişki Johansen-Juselius (1990) eşbütünleşme testleri ile kısa dönemli ilişki Granger Nedensellik testi ile nedenselliğin yönü ise Vektör Hata Düzeltme Modeli kullanılarak test edilmiştir. Çalışmanın bulguları, Türk Bankacılık sektöründe takipteki krediler ve belirleyicileri arasında tutarlı ve uzun dönemli bir ilişkinin var olduğunu göstermektedir. Vektör Hata Düzeltme Modeli kullanılarak yapılan Granger nedensellik testleri, kısa dönemli ilişkinin olduğu durumlarda ilişkinin tek yönlü olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Takipteki Krediler, Eşbütünleşme, Vektör Hata Düzeltme, Türk Bankacılık Sektörü

1. INTRODUCTION

The determinants of default risk are a special concern for regulatory authorities, whose concern is to generate financial stability and monitor the management of banks. Specifically, the recent global financial crisis highlighted the significance of the fragility of the banking system within the context of the default risk. The default risk of credit takes the form of Non-Performing Loans (NPLs), when the delinquency of principal and interest payment of more than 90 days occurs. NPLs, a vital issue for bank managers, regulatory authorities, academic communities and investors, are often regarded as an unnoticed indicator in the banking system.

The regular monitoring and managing of the quality of the loan is of great significance for the

soundness of the financial system. The deterioration of the loan quality can result in significant losses for banks, and hence, may even cause the inception of a banking crisis (Reinhart and Rogoff, 2010). Therefore, there has been an increasing interest among policy makers and academics, which has led the exploration of the determinants of nonperforming loans.

Several empirical studies in the banking literature have been devoted to the investigation of the relationship between NPLs and their determinants at the aggregate level, by using either macroeconomic variables or bank-specific determinants as the explanatory variables. Among the studies examining only the macroeconomic determinants of default risk, previous research by Keeton and Morris (1987) shows that the variation in the loan losses was due to dif-

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ferences in economic conditions, and to the unusually poor performance of certain industries. Rinaldi and Sanchis-Arellano (2006) report that household NPLs in European countries depend on a set of three macroeconomic variables: current income, unemployment rate, and monetary conditions. Berge and Boye (2007) argue that problem loans are highly sensitive to the real interest rates and unemployment in the Nordic banking system over the period 1993-2005. Additionally, Nkusu (2011), who investigate the macroeconomic determinants of NPLs ratio for 26 advanced economies over the period 1998-2009, find that adverse macroeconomic developments¹ are associated with rising NPLs. In another study, Kauko (2012) analyzes Japanese banks, stressing the fact that rapid credit growth in the period 2000-2005 could only have projected the relative amount of non-performing loans if combined with a current account deficit. Thangavelu and Hu (2005) point out that governments should enforce strict budget constraints on both State Owned Enterprises and State Owned Banks to prevent the formation of a new cycle of non-performing loan accumulation. Park (2012) finds some evidence that corruption distorts the allocation of bank funds from normal to bad projects, resulting in a decrease on the quality of private investments, hence it decreases economic growth. Other studies focusing on the macroeconomic determinants of NPLs include Cifter et al. (2009), and Segoviano et al. (2006).

Alternative studies of the literature provide empirical evidence on the impact of bank specific characteristics on NPLs. Girardone et. al. (2004) investigate the relationship of NPLs with capital strength and inefficiencies on Italian Banking sector; finding that inefficient banks always appear to have lower levels of equity/assets and higher levels of non-performing loans. Barseghyan (2010) analyzes the determinants of investment, labor productivity, NPL level and total factor productivity on banks' productivity. Breuer (2006) examines the effect of a very wide range of firm-specific variables on NPLs. Berger and De Young (1997) shed light on the links between the bank-specific variables by focusing on efficiency indicators and problem loans. In a sample of US commercial banks spanning the period from 1985 to 1994, they find a relationship between bank-specific characteristics relating to efficiency and capital adequacy, and the characteristics of 'bad luck', 'bad management', 'skimping' and 'moral hazard'. The results of this study indicate that decreases in cost efficiency generate an increase in the future NPL volumes. Podpiera and Weill (2008), who observe the relationship between

efficiency and NPLs in the Czech banking industry from 1994 to 2005, provide an empirical evidence for a negative correlation between decline in cost efficiency and future NPLs. In another study by Barros et al. (2012), NPLs are found to represent a significant burden for banks' efficiency performances, and further restructuring process is needed in the segment of Regional Japanese Banks. Li et al. (2007) find that incentive contracts, including motivational payments, have a positive effect on managerial efforts to diminish the volume of NPLs in the Chinese banking system.

Salas and Saurina (2002) combine macroeconomic and microeconomic variables to explain aggregate NPLs of Spanish Commercial and Savings Banks in the period 1985-1997. Their study focuses on the determinants of NPLs for commercial and savings banks. The paper concludes that bank-specific determinants are early warning signs for future changes in NPLs. Louzis, Vouldis and Metaxas (2012) include both macroeconomic and bank-specific variables, based on predictions that NPLs can be explained by the following determinants: GDP, unemployment, interest rates, public debt and management quality.

The aim of this paper is to investigate the relationship between nonperforming loans and their bank-specific and macroeconomic determinants in the Turkish banking system, using Johansen-Juselius (1990) cointegration tests; short-run dynamics is tested through Granger Causality test, and the direction of the causality through the Vector Error Correction Model (VECM). Considering the development of non-performing loans in the Turkish banking system, outsourcing policies followed after 1980s, increasing costs of credit, macroeconomic instability, the increase in the foreign exchange and interest rate rise through the 2001 crisis have been effective in the emergence of the non-performing loans problem in Turkey. After the crisis, BRSA faced with the problem of non-performing loans, which reached nearly one-third of the total loan portfolio. The rise in the ratio of non-performing loans over total loans has negative effects on the bank performance. The higher ratio of non-performing loans results in an increase in the allowance for Loan and Lease Losses (ALLL), and therefore in the deterioration in the quality of the loan portfolio and decline in the net asset profitability of the banks. Hence, it is worthwhile to investigate the determinants of non-performing loans. As the determinants of nonperforming loans can vary across countries, one should be careful when formulating policy proposals based on the results obtained by the studies. Identification of the determinants of the non-

performing loans, such as macroeconomic or/and bank specific factors, will enable countries to implement some policies to have a more stable economy and banking system.

The present study contributes to the current literature in three main ways: Firstly, the paper considers two distinct types of determinants, namely macroeconomic (overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit) and bank-specific determinants (volume of individual loans, volume of bankcards and total saving deposits). Secondly, the paper focuses on the Turkish banking system, which may be considered to represent a benchmark for strong recovery in the period following the 2000-2001 banking crisis. Within the years 1999-2001, the Turkish economy has been exposed to two severe economic and financial crises. Volatile GDP growth, unsustainable huge public debt, high and variable inflation rate, increasing interest rate, as well as uncertainties in the political environment were the main reasons of these crises. During this period, the lack of risk and corporate management and transparency, maturity mismatch problem, capital inadequacy, negative effect of dollarization on the resource structure and deposits, weak asset quality, high exposure to market risks, small-scaled and fragmented banking structure, distorting effect of state-owned banks were effective in the deterioration of the Turkish banking system and in the transformation of the exchange rate crisis into a systemic bank crisis (BDDK, 2009). Within this framework, the continuous increasing trend of the nonperforming loans to gross loans ratio over this period played a significant role in the deterioration of the financial structures of the banks, and these banks were transferred to Savings Deposit Insurance Fund (SDIF hereafter).

Within the aim of preventing the deepening of the banking crisis and establishing a more stronger, effective and competitive banking environment, the Banking Sector Restructuring Program was introduced in May 2001 by the Turkish Banking Regulation and Supervisory Agency (BRSA). As a result of structural measures and improvements initiated by the BRSA, the capital structures of the state-owned banks had been strengthened, some regulations steps were promoted to facilitate the merger and acquisition activities to eliminate the fragmented structure of the banking system (BDDK, 2009). Following 2000-2001 crises, Turkish banking sector has also been exposed to the global economic crisis, which was originated in the US with the collapse of the sub-primes mortgage market in the 2007 and hit the real economies

of all countries in the world. However, the effects of the global financial crisis on the Turkish banking sector were relatively limited because of after 2000-2001 crises, the strong capital structure, high asset quality, low non-performing loans ratio, low currency and liquidity risks through the measures taken by the Central Bank of Republic of Turkey (CBRT hereafter) and BRSA. Therefore, due to the recent economic development financial developments in Turkey, focusing on the Turkish banking system may serve as a benchmark for the study of banking crisis within the framework of non-performing loans. Finally, to the best of authors' knowledge, this is a pioneering study that attempts to investigate the linkages among the nonperforming loans and its determinants by utilizing a unique data set over the period 2007 through 2013. Despite the relatively small data set, the period chosen represents an important post-crisis era. The volume of non-performing loans is the dependent variable. The time series properties of the quarterly data are used for Turkey for the period 2007-2013. In this paper, an empirical research will be performed in order to test long-run and short-run dynamics of the variables.

The brief summary of the methodology used in this paper is as follows; an autoregressive model is used to ensure stationarity features of the variables, cointegration tests are used to analyze the causal relationship among non-performing loans, volume of individual loans, volume of bankcards, total saving deposits, overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit. The correlative short run relations between the variables are tested with Granger causality test, and a Vector Error Correction (VEC hereafter) specification is utilized to examine the direction of this causality. The causal impact is examined via Generalized Impulse Response Analysis. Impulse response functions (IRFs) are employed to evaluate the effect of a shock to non-performing loans on the regressors and the effect of a shock to the regressors on non-performing loans, the duration of the effects. The Variance Decomposition is employed to determine how much of the variance in non-performing loans can be explained by the exogenous shocks to the capital regressors.

The organization of the paper is as follows. Section 2 introduces the data and the methodology. Section 3 is reserved for empirical analysis and finally Section 4 concludes the paper.

2. THE MODEL AND THE METHODOLOGY

2.1. The Model

$$npl_t = F(vil_t, vbc_t, tsd_t, r_t, u_t, i_t, y_t, ca_t) \quad (1)$$

where npl denotes the non-performing loans, the inputs vil , vbc , tsd , r , u , i , y , ca connote the volume of individual loans, volume of bankcards, total saving deposits, overnight lending interest rate of Central Bank of Republic of Turkey (CBRT hereafter), unemployment rate, inflation rate, GDP per capita, and current account deficit respectively, and the subscript t denotes the time period. As seen from the equation, all the variables in the function vary over time, implying that, in the empirical study, they have time-variant values.

All of the variables in the function are predicted to have a long run relationship. In order to test the relationship among the non-performing loans and its regressors, and their long-run movements, it is essential to consider the equation in growth form. It is necessary to note that all the variables used in the empirical study are in their natural logarithmic forms, so that their first differences yield their growth rates by reason of their consistency to the model. In this study, the terms 'L' and 'D' precede the variables to connote the natural logarithm and the first differences of natural logarithm respectively.

2.2. Cointegration tests and Granger causality Models

The cointegrating relation between non-performing loans, volume of individual loans, volume of bankcards, total saving deposits, overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit is examined with the Johansen procedure, developed in Johansen and Juselius (1990), Johansen (1991,1995). The existence of long-run relationship among variables is estimated via the stationarity feature of the linear combination of the series those are non-stationary in levels.

Considering a Vector Autoregression (hereafter VAR) of order n :

$$Y_t = A_1 Y_{t-1} + \dots + A_n Y_{t-n} + B X_t + \varepsilon_t \quad (2)$$

where Y_t is a k -vector of variables those are integrated of order one, denoted as $I(1)$, X_t is a z -vector of deterministic variables, and ε_t is a vector of innovations.

$$\Delta Y_t = \pi Y_{t-1} + \sum_{i=1}^{n-1} \Gamma_i \Delta Y_{t-i} + B X_t + \varepsilon_t \quad (3)$$

$$\pi = \sum_{i=1}^n A_i \text{ and } \Gamma_i = - \sum_{j=i+1}^n A_j \quad (4)$$

According to Granger's theorem, if the coefficient matrix π has a reduced rank $r < k$, there exists $k \times r$ matrices α and β each with rank r , such that $\pi = \alpha \beta'$, and $\beta' Y_t$ is stationary in level. The Johansen approach tests the cointegrating rank where each column of β represents the cointegrating vector, and estimates the adjustment parameters used in VEC model which are the elements of α . The Johansen suggests two likelihood ratio tests of the significance of the correlations: the trace test, and the maximum eigenvalue (λ_{max}) test. The trace statistic tests the null hypothesis of the existence of at most r cointegrating relations against the alternative of m cointegrating relations for $r=0,1,\dots,m-1$. The maximum eigenvalue statistic tests the null hypothesis of the existence of r cointegrating relations against the alternative of $r+1$ cointegrating relations.

The existence of a cointegration vector is an essential and sufficient condition to proceed with the VEC model. To test for causality in the Granger sense, the autoregressive specification of a multivariate VAR is used. A VEC model for the Granger causality test is estimated for the case following Engle and Granger (1987), Granger (1988). The VEC model is represented in Equation 5;

$$\begin{aligned} \Delta npl_t = & \theta_1 + \sum_{k=1}^r \alpha_{1,k} \beta_{k,t-n} + \sum_{s=1}^n \zeta_{1,s} \Delta npl_{t-s} + \\ & \sum_{s=1}^n \zeta_{2,s} \Delta vil_{t-s} + \sum_{s=1}^n \zeta_{3,s} \Delta vbc_{t-s} + \\ & \sum_{s=1}^n \zeta_{4,s} \Delta tsd_{t-s} + \sum_{s=1}^n \zeta_{5,s} \Delta r_{t-s} + \\ & \sum_{s=1}^n \zeta_{6,s} \Delta u_{t-s} + \sum_{s=1}^n \zeta_{7,s} \Delta i_{t-s} + \end{aligned} \quad (5)$$

where n is the lag order selected as to the information criterion such as Akaike (AIC), Schwarz (SIC), and Hannan-Quinn (HQ), and the final prediction error. The parameter θ_1 denotes the intercept, and the symbol Δ is the difference of the concerning variable. The parameters $\beta_{k,t-n}$ are the cointegrating vectors derived from the cointegrating relationships in Johansen Cointegration test and $\alpha_{1,k}$ is the adjustment coefficient estimated by the cointegrating vectors. The Granger Causality tests among the variables are performed using the VEC models in Equation 5 via the following two steps;

i. For the long-run analysis, t-tests are applied on the adjustment coefficients to examine the statistical significance of the lagged Error Correction terms (hereafter ECTs).

ii. For the short-run analysis, joint F-tests are applied to the coefficient of each independent variable in one equation in order to test the causal relationship among variables in the Granger sense. For instance, the null hypothesis $H_0: \zeta_{2,1} = \zeta_{2,2} = \dots = \zeta_{2,n} = 0$ is tested to examine whether volume of individual loans Granger-causes non-performing loans in Equation (5).

3. THE DATA AND THE STATISTICAL TESTS

3.1. Data and Discussions

This section of the study attempts an application of the model discussed above. Here, there will be an analysis of Turkish data for the existence and the direction of the causality among non-performing loans and the volume of individual loans, volume of bankcards, total saving deposits, overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit. The

period of analysis is limited to 2007-2013, due to the availability of the data.

In this paper, the quarterly time-series data are drawn together from various sources. The data of the non-performing loans, i.e. the dependent variable of the model, is taken from the Banking Regulation and Supervision Agency (BRSA hereafter)². The data for the volume of individual loans, the volume of bankcards, and the total saving deposits are also from BRSA. The overnight lending interest rate of Central Bank of Republic of Turkey (CBRT hereafter) is taken from CBRT. The GDP in national currency, current prices, the unemployment rate, and the current account deficit is taken from OECD STATS³. The data for GDP per capita is calculated using the population data that is obtained from The Conference Board of Total Economy Database, January 2012, and is expressed per thousand people⁴. Finally, the data for the inflation rate is drawn from Turkish Statistical Institute (TSI hereafter)⁵. Table 1 presents the descriptive statistics for Turkey of the variables employed in the study. The series are in their natural logarithmic forms.

Table 1. Descriptive Statistics of Data

Variable	Mean	Min.	Max.	Std.Dev.
<i>Non-performing Loans (npl)</i>	21.99	20.71	22.57	0.49
<i>Volume of Individual Loans (vil)</i>	25.57	24.94	26.24	0.41
<i>Volume of Bank Cards (vbc)</i>	24.56	24.02	25.15	0.36
<i>Total Savings Deposit (tsd)</i>	26.59	26.14	26.98	0.24
<i>Inflation (i)</i>	2.05	1.37	2.41	0.25
<i>Unemployment (u)</i>	2.26	2.07	2.59	0.15
<i>RTCB Credit O/N (r)</i>	2.38	1.87	3.00	0.16
<i>GDP per capita (y)</i>	15.12	14.89	15.40	0.17
<i>Current Account Deficit (ca)</i>	22.98	19.95	23.76	0.83

Notes to Table 1: Max., Min. and SD denote maximum, minimum and standard deviation, respectively.

Table 2. Correlation Matrix of Data

	npl	vil	vbc	tsd	i	u	r	y	ca
npl	1								
vil	0.7338	1							
vbc	0.7425	0.9852	1						
tsd	0.8386	0.9814	0.9762	1					
i	-0.328	-0.1207	-0.0808	-0.179	1				
u	-0.0288	-0.6526	-0.6126	-0.5138	-0.2423	1			
r	-0.9286	-0.705	-0.6903	-0.7886	0.4889	0.0302	1		
y	0.6639	0.9915	0.9741	0.9547	-0.0725	-0.7359	-0.6423	1	
ca	0.086	0.5197	0.4421	0.3951	0.0471	-0.7419	-0.1881	0.5899	1

Note: npl, vil, vbc, tsd, i, u, r, y and ca represent nonperforming loans, volume of individual loans, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, GDP per capita and current account deficit, respectively.

In Table 2, the correlation coefficient measures the strength and direction of a linear relationship between two variables. For instance, while there is a strong linear positive relationship between non-performing loans and volume of bankcards, there exists a strong linear negative relationship between non-performing loans and O/N lending interest rate.

3.2. Unit root tests

The stationarity features of the variables are analyzed via unit root tests. It is necessary to be certain that all the series are integrated in the same order to ensure the applicability of cointegration tests, and VEC analyses. There are various unit root tests which can rarely work through different results. In this paper, for the robustness of the results, augmented Dickey–Fuller (ADF) is employed for the variables in the study.

In such analyses, it should also be considered that the unit root tests vary in different lag structures; therefore, in this study, for ADF test, two lag selection information criteria, namely Schwarz Information Criterion (SIC), and Akaike Information Criterion (AIC), are performed in order to confirm the results. Here, we represent the results obtained via AIC, since both of the lag selection criteria yield similar results. The tests cover an intercept in the levels, and an intercept in first differences. The results of the unit root tests show that the variables are stationary in their first difference data, i.e. I(1). The data are in 1%, 5% and 10% critical value range for ADF test. The results reveal that all the series are non-stationary at levels and stationary in first differences, though at different significance levels. Hence, in general, all variables are integrated of the same order: I(1).

Table 3. Unit root test results of all variables in the study

PANEL A: LEVEL		ADF
	Lnpl	-0.3285(5)
	Lvil	-0.0256(0)
	Lvbc	-1.0910(5)
	Ltsd	-1.1797(0)
	Lr	-1.6256(0)
	Lu	-1.6943(1)
	Li	-2.3166(4)
	Ly	0.3738(2)
	Lca	-2.1277(0)
PANEL B: FIRST DIFFERENCE		ADF
	Dnpl	-2.8145*(3)
	Dvil	-4.5162*** (0)
	Dvbc	-4.3929*** (0)
	Dtsd	-5.5867*** (0)
	Dr	-3.5709** (0)
	Du	-2.5896** (0)
	Di	-6.3637*** (3)
	Dy	-3.8317*** (1)
	Dca	-5.3814*** (0)

Notes to Table 3: The null hypothesis is the existence of unit root for ADF test. In the tables, superscripts ***, **, * in bold denote the rejection of the null hypothesis at 1%, 5% and 10% significance levels, respectively. ADF critical values are due to MacKinnon (1996). Lag lengths for ADF tests are in parentheses. Lnpl, Lvil, Lvbc, Ltsd, Li, Lu, Lr, Ly and Lca stand for the natural logarithm of nonperforming loans, volume of individual loans, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, GDP per capita and current account deficit, respectively. Dnpl, Dvil, Dvbc, Dtsd, Di, Du, Dr, Dy and Dca represent first difference of nonperforming loans, volume of individual loans, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, GDP per capita and current account deficit, respectively.

3.3. Cointegration tests

Once the orders of integration of the variables are determined via unit root tests and we ensure that all the variables are integrated of order one, i.e., $I(1)$, we now employ Johansen (1991), Johansen (1995), and Johansen and Juselius (1990) techniques to test for cointegration among variables within a model in Equation (3). The optimal lag length selections in

the VAR must be satisfied to apply Johansen's approach, which is relatively sensitive to lag lengths. In this study, the optimal lag selections are based on SIC and Final Prediction Error (FPE). Pesaran and Shin (1999) states that SIC is more consistent than both AIC and Hannan-Quinn information criterion. The results of the tests for cointegrating rank, the maximum eigenvalue (λ_{max}) and trace tests are reported in Table 4, together with 5% critical values and p -values.

Table 4. Results of Cointegration Test

	H_0	H_1	Statistics	5%	p-value		H_0	H_1	Statistics	5%	p-value
	$r=0$	$r \geq 1$	360.45	197.37	0.00	λ_{max}	$r=0$	$r=1$	145.93	58.43	0.00
Trace	$r \leq 1$	$r \geq 2$	214.52	159.52	0.00		$r \leq 1$	$r=2$	71.06	52.36	0.00
	$r \leq 2$	$r \geq 3$	143.45	125.61	0.00		$r \leq 2$	$r=3$	51.13	46.23	0.01
	$r \leq 3$	$r \geq 4$	92.32	95.75	0.08		$r \leq 3$	$r=4$	34.31	40.07	0.19
Normalized Cointegrating Coefficients on LGDP											
Lnpl			Lvil	Lvbc	Ltsd	Lr	Lu	Li	Ly	Lca	
1.00			3.63 ^a (0.11)	-2.47 ^a (0.06)	-7.75 ^a (0.16)	-0.67 ^a (0.03)	-0.75 ^a (0.12)	-0.08 ^a (0.01)	4.32 ^a (0.40)	-0.23 ^a (0.01)	

Notes to Tables 4: λ_{max} denotes maximum eigenvalue, and r denotes rank. For normalized cointegration coefficients, standard errors are in parentheses. The superscripts, a, b and c denote the significance at 1%, 5% and 10% critical level respectively. p -values are sourced from MacKinnon-Haug-Michelis (1999). Lnpl, Lvil, Lvbc, Ltsd, Li, Lu, Lr, Ly and Lca stand for the natural logarithm of non-performing loans, volume of individual loans, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, GDP per capita and current account deficit, respectively.

Table 4 reports the results of cointegration among non-performing loans, volume of individual loans, volume of bankcards, total savings deposit, overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit. The lag interval is determined as 1, and linear deterministic trend exists in data. Only intercept is considered in cointegration equation. Trace test and maximum eigenvalue test both indicate the existence of three cointegrating equations at 5% significance level. This means that there are three long-term stable relationships among these variables. In other words, long run movements of the variables are determined by three cointegrating relationships.

As far as the results of cointegrating equation normalized on non-performing loans are concerned, the results of Johansen cointegration approach prove the existence of long-run cointegration at 1% significance level. The signs are reversed to enable proper interpretation. Only two variables, the volume of individual loans and GDP per capita have a negative significant relationship with non-performing loans, whereas all other variables, namely, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, and current account deficit have a

positive and statistically significant impact on non-performing loans. All variables, in general, present the expected signs with the non-performing loans, except for volume of individual loans, and total saving deposits. In the long-run, income per capita is expected to be negatively related with the non-performing loans, which suggests that higher income level increases the debtors' ability to repay installments of the loan, thereby decreasing the ratio of non-performing loans. With regard to overnight lending interest rate of CBRT, it directly leads to an increase in the cost of maintaining capital for a bank, and thereby, a rise in the cost of loans and non-performing loans. The interest rate has the expected positive sign and statistically relationship with the non-performing loans in Turkish banking system.

Inflation and unemployment are found to be positive and have statistically significant impact on non-performing loans. A higher inflation decreases the purchasing power of the debtors, thereby decreasing the ability to repay the loans. Additionally, higher inflation is directly related with higher interest rate, resulting in a decline in the debtors' ability to repay. If the level of unemployment increases, the ability to pay back/ collect individual loans is weakened. It is

certain that amount of NPLs will increase with a rise in the level of unemployment. Moreover, the need for capital will positively affect the volume of individual loans positively, but in an unstable economy, the interest rates will also tend to rise. As a matter of fact, the volume of NPLs, NPL ratios will tend to increase in such a scenario.

The volume of individual loans and the volume of bankcards are expected to be positively related to non-performing loans, suggesting that increasing volume of credit directly causes greater risk, resulting in more non-performing loans volume on the balance sheet. Even if the volume of bankcards presents the expected sign, for the volume of individual loans, the sign is opposite. Total saving deposit is expected to be negatively related to non-performing loans, which provides support for the argument that as individuals allocate some income as saving, their need for credit/loan falls. This leads to a decline in the volume of non-performing loans. However, the result is not consistent with expectations. The coefficient of the current account deficit is found to be positive and statistically significant in the explanation of bank non-performing loans.

3.4. VEC Model and Granger Causality Analysis

Once the cointegration among variables is confirmed, the succeeding procedure is to estimate long-run and short-run coefficients via t-statistics and F-statistics respectively. The number of lags is one for short-run F-statistics. There are three cointegration equations determined by Johansen Cointegra-

tion, as presented in t-statistics of lagged ECTs. Table 5 reports the Granger causality test results. In Table 5, the first error-correction term (ECT) (normalizing on Lnpl) is significant in volume of individual loans and current account deficit equations at 1%, in non-performing loans equation at 5%, and in volume of bankcards, unemployment and GDP per capita equations at 10%. The second ECT (normalizing on vil) and the third ECT (normalizing on vbc) are also presented in Table 5. For the first ECT (normalizing on Lnpl), the deviations from cointegration between variables, except for total savings deposit, overnight lending interest rate and inflation rate, are corrected to return the long-run equilibrium for each period. In the short-run dynamics, GDP per capita is significant in overnight lending interest rate equation at 1%, and overnight lending interest rate is significant in GDP per capita at 10%. This indicates a bi-directional causality. The unemployment rate and GDP per capita is significant in non-performing loans equation at 1%. These findings strongly suggest a uni-directional causality running from GDP per capita to non-performing loans, and unemployment rate Granger causes non-performing loans in the short-run. This means that current values of non-performing loans can be predicted by using the past values of GDP, and also that unemployment rate and/or GDP and unemployment rate provide statistically significant information about the future values of non-performing loans. Therefore, only GDP and unemployment rate are stimulus for the prediction of the non-performing loans.

Table 5. Granger Causality test results

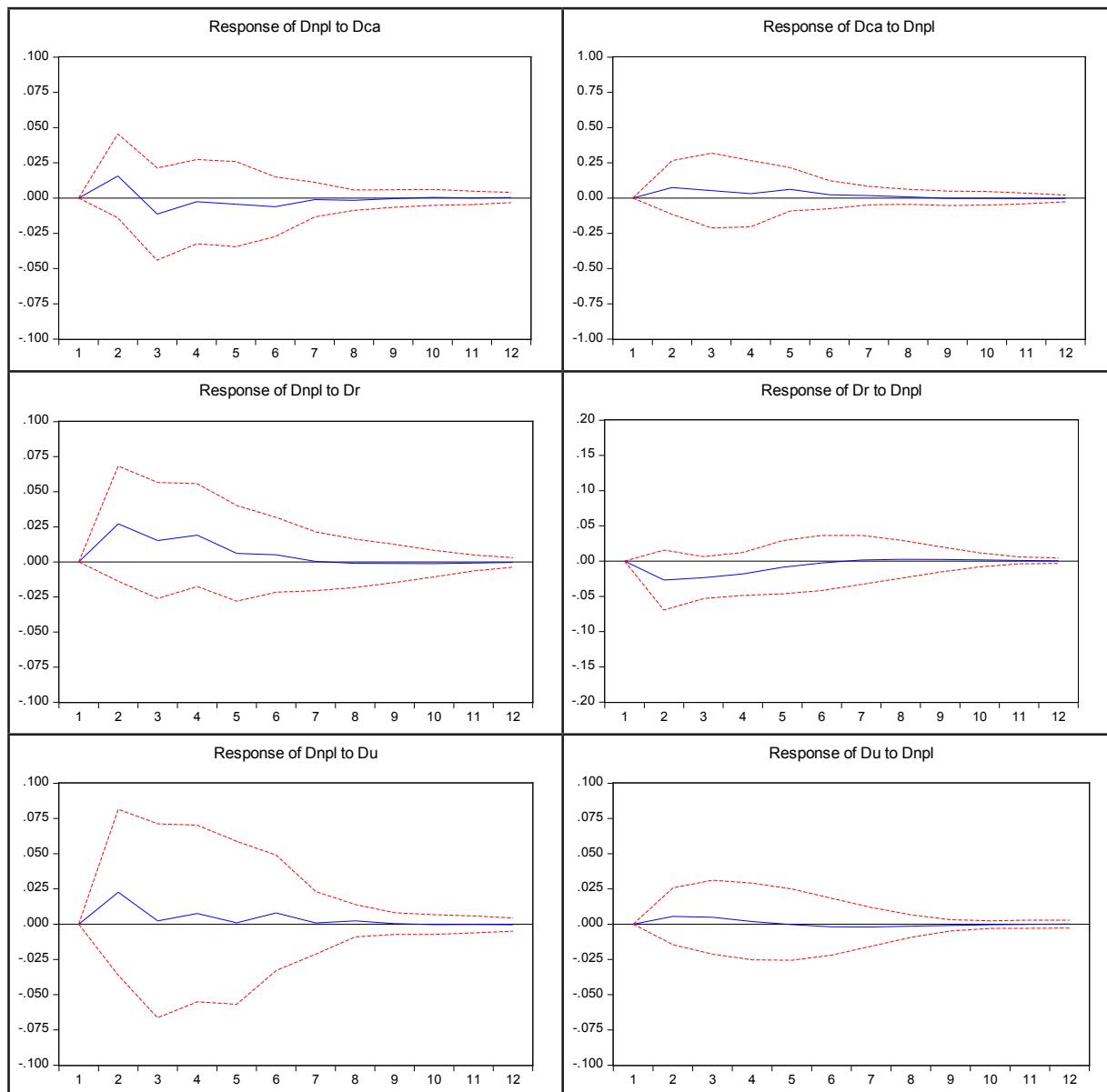
Equation	Short-Run									Long-Run		
	Dnpl	Dvil	Dvbc	Dtsd	Dr	Du	Di	Dy	Dca	ECT _{1,t-1}	ECT _{2,t-1}	ECT _{3,t-1}
	F-statistics									t-statistics		
Dnpl	-	1.95	1.56	0.53	0.51	8.08 ^a	0	8.72 ^a	0.15	-2.33 ^b	0.17	1.57
Dvil	2.45	-	1.23	1.13	0.02	4.99 ^a	0.09	18.98 ^a	1.39	-3.33 ^a	-6.47 ^a	-4.66 ^a
Dvbc	1.53	1.22	-	0.56	0.01	3.97 ^c	0.37	5.09 ^b	0.29	1.91 ^c	-1.33	4.21 ^a
Dtsd	0.96	0.37	1.17	-	0.06	1.23	0.07	0.18	0.74	-1.47	0.83	-0.6
Dr	3.52 ^c	1.64	0.37	0.01	-	6.66 ^a	0.43	7.64 ^a	0.21	0.06	-0.33	-2.19 ^b
Du	0.15	0.13	0.02	0.01	0.21	-	0.01	4.73 ^b	2.44	1.77 ^c	2.08 ^b	0.75
Di	0.59	0.87	0.02	0.02	0.38	5.12 ^a	-	4.23 ^b	0.44	-0.37	0.26	-1.80 ^c
Dy	0.99	1.49	2.46	2.44	3.65 ^c	0.02	1.15	-	0.1	-1.75 ^c	-1.13	-2.46 ^b
Dca	1.37	0.97	1.21	7.18 ^a	0.41	3.81 ^b	0.34	3.37 ^c	-	4.43 ^a	1.66	-3.42 ^a

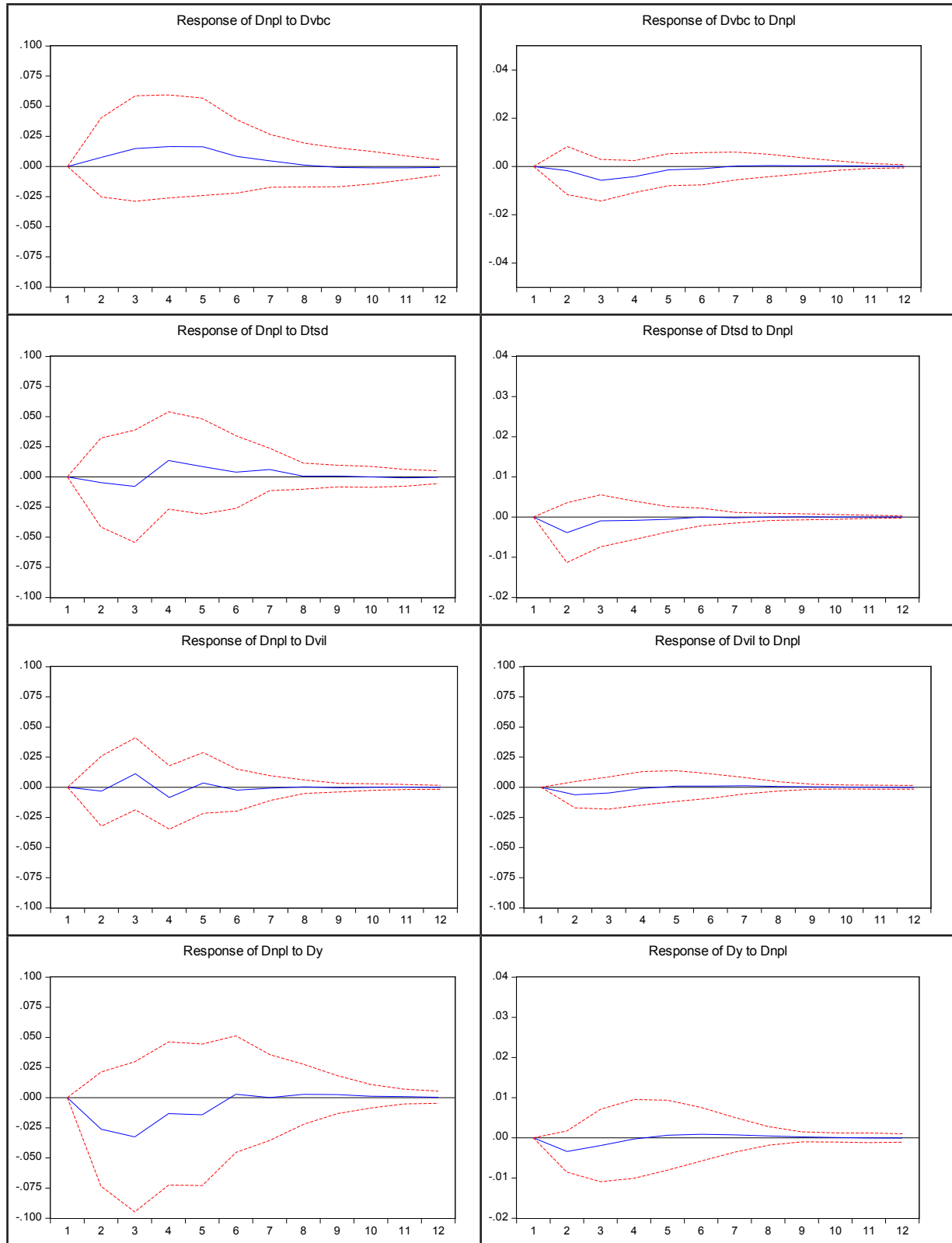
Notes: The superscripts a, b, and c denote significance at 1% and 5% and 10% critical levels respectively. Dnpl, Dvil, Dvbc, Dtsd, Di, Du, Dr, Dy and Dca represent first difference of nonperforming loans, volume of individual loans, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, GDP per capita and current account deficit, respectively.

3.5. Generalized Impulse Response and VAR Variance Decomposition Analysis

The Generalized Impulse Responses (Pesaran and Shin, 1998) are employed to examine the impact of a shock to one variable on another, and to observe the period of existence of the impacts. An impulse response function (IRF) concerns with the impact of a one-time shock to one of the innovations on current and future values of the endogenous variables.

The Generalized Impulse Response results are illustrated in Figure 2. The VAR is composed for Dnpl, Dvil, Dvbc, Dtsd, Dr, Du, Di, Dy, Dca; however, only the impulse responses among non-performing loans and its regressors are presented due to limited space. The impulse responses are for 12 periods. The point estimates of the IRFs are shown by solid lines, whereas a two standard deviation band around point estimates are illustrated by dotted lines. It is worth noting that the response standard errors are asymptotic.





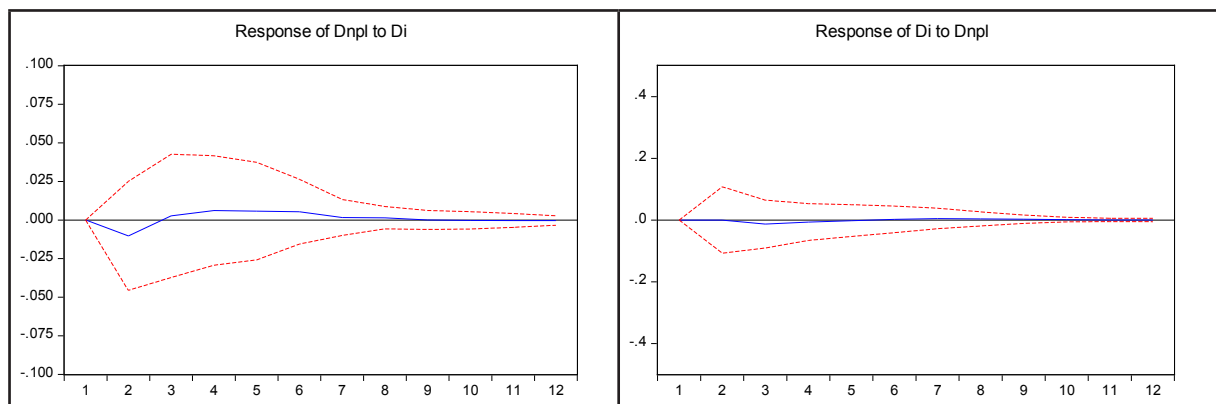


Figure 1. Generalized Impulse responses between npl and the regressors

Yuan et al. (2008) claims that point estimates are significant if the bands cross zero. Following Yuan et al. (2008), we can say that there is significance in both the response of non-performing loans to the shocks in the regressors, and the response of the regressors to the shocks in non-performing loans. From Figure 1, we can see that the effects of the shocks last in at most eight periods.

While Granger causality results present the qualitative relationship between the variables, variance decomposition analysis provides a quantitative measure to these causal relationships, representing how much of the movement in non-performing loans can be explained by other variables, in terms of the forecast error variance of the non-performing loans. The variance decomposition divides the variation in endogenous variable into the component shocks to the VAR, giving information about the relative importance of the impact of each innovation on the variables in VAR. The variance decomposition of non-performing loans is presented in Table 6. This specification is also the Cholesky ordering for the model. The results indicate that at the 12 year horizon, 94.46% of the variation in non-performing loans can be explained by its own innovations, whereas changes in other variables explain only 5.54% of the variance in the non-performing loans. Inflation seems to explain between 1.90% and 2.90% of the forecast error variance of non-performing loans at the 12-year horizon, which represents the largest impact at each horizon. In contrast, among these variables, GDP per capita has the smallest impact on the explanation of the variation in non-performing loans, starting from the 3rd.

4. CONCLUDING REMARKS

Within the framework of empirical models, this paper examines the existence and direction of causality among non-performing loans, volume of individual loans, volume of bankcards, total saving deposits, overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit. The time series analysis covers only the period 2007-2013 for Turkey, due to the

limited availability of quarterly data. The results of Johansen cointegration approach provides strong evidence for the existence of three long-run cointegrating relationships among non-performing loans, volume of individual loans, volume of bankcards, total saving deposits, overnight lending interest rate of CBRT, unemployment rate, inflation rate, GDP per capita, and current account deficit. Only the volume of individual loans and GDP per capita has a negative significant relationship with non-performing loans, whereas all other variables, namely, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, and current account deficit have a positive and statistically significant impact on non-performing loans. All variables, in general, present the expected signs with the non-performing loans, except for two: the volume of individual loans and total saving deposits. Following this, employing a VEC model, it is concluded that unemployment rate and GDP per capita Granger causes non-performing loans in the short-run in Turkey. This means that current values of non-performing loans can be predicted by using the past values of GDP and unemployment rate, and/or GDP and unemployment rate, which can provide statistically significant information about the future values of non-performing loans. Therefore, GDP and unemployment rate alone can be considered stimulus for the prediction of the non-performing loans.

The results of this study have important policy implications for banks and policy makers aiming to decrease the level of non-performing loans. The assessment of loan quality and credit risk in the financial sector is an important element of the macro-prudential surveillance. Therefore, a detailed understanding of drivers of non-performing loans has the potential to facilitate the identification of the key vulnerabilities in the financial sector. In order to maintain the soundness and stability of the banking system, it is important that banks and policy makers give the required attention to macroeconomic and bank-specific variables when offering loans, in order to decrease the level of non-performing loans.

Table 6. VAR Variance Decomposition of Dnpl

Horizon	S.E.	DNPL	DCAD	DGDPPC	DINF	DTRCB	DTSD	DUNEMP	DVBC	DVIL
1	0.069155	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.119235	96.56001	0.369941	0.060400	1.917487	0.156901	0.252681	0.509257	0.169825	0.003502
3	0.143126	94.18547	0.256764	0.043753	2.828447	0.289126	0.581096	1.197477	0.411195	0.206673
4	0.165167	94.94446	0.386041	0.035249	2.451576	0.217934	0.484963	1.002481	0.321787	0.155509
5	0.185984	94.35913	0.338194	0.031085	2.792969	0.189199	0.566848	1.172272	0.376296	0.174009
6	0.202600	94.47177	0.332870	0.026535	2.741683	0.180089	0.560424	1.161667	0.359611	0.165347
7	0.219349	94.50423	0.336287	0.022819	2.752703	0.159296	0.558813	1.159159	0.351381	0.155310
8	0.234299	94.43446	0.323932	0.020076	2.795994	0.153432	0.571933	1.187319	0.355987	0.156866
9	0.248418	94.48303	0.325463	0.017860	2.781721	0.143982	0.568137	1.180273	0.348490	0.151050
10	0.261934	94.45971	0.321044	0.016152	2.802805	0.137278	0.573158	1.191153	0.349040	0.149658
11	0.274605	94.46479	0.318676	0.014707	2.805880	0.132526	0.574411	1.194290	0.347013	0.147709
12	0.286833	94.46851	0.317443	0.013509	2.810263	0.127574	0.575278	1.196461	0.345301	0.145664

Note: "S.E." is forecast error of the variable at the given forecast horizon. The remaining columns give the percentage of the forecast variance due to each innovation, with each row adding up to 100. Dnpl, Dvil, Dvbc, Dtsd, Di, Du, Dr, Dy and Dca represent first difference of nonperforming loans, volume of individual loans, volume of bank cards, total saving deposits, inflation, unemployment, RTCB Credit O/N, GDP per capita and current account deficit, respectively.

END NOTES

¹ Adverse macroeconomic developments refer to a contraction of real GDP, a higher unemployment rate, higher interest rates, a fall in house prices and a fall in equity prices.

² <http://ebulten.bddk.org.tr/haritalama/harita.aspx>

³ <http://stats.oecd.org/>

⁴ <http://www.conference-board.org/data/economydatabase/>

⁵ <http://www.tuik.gov.tr/>

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